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AUTHOR Machiels-Bongaerts, Maureen; And Others
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ABSTRACT

Two hypotheses, the cognitive capacity hypothesis and the selective attention hypothesis, try to account for the facilitation effects of prior knowledge activation. They appear to be mutually exclusive since they predict different recall patterns as a result of prior knowledge activation. This study was designed to determine whether the two hypotheses are mutually exclusive, or whether they only appear to be diametrically opposed. Two groups of 10 subjects participated in experiments providing support for the two hypotheses. One group, the "problem group," activated knowledge that corresponded with the problem information of a text that described the consequences of fishery policies for a small (hypothetical) village in Portugal. The recall pattern of this group was expected to reflect the predictions of the cognitive capacity hypothesis. The other group (the tourism group) was expected to show the recall pattern predicted by the selective attention hypothesis as group members tried to fill the slots of schema mobilized prior to the study by constantly selecting matching information. Results indicate that both hypotheses could be valid. The problem group showed an increase in new information while recall of activated information was not impaired, as predicted by the cognitive capacity hypothesis. The problem group also recalled more information than did the other group, and their recall protocols showed more relations linking the concepts of the text. Findings indicate that these hypotheses only appear to be mutually exclusive. Two tables contain study data. (SLD)

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THE EFFECT OF PRIOR KNOWLEDGE ACTIVATION ON TEXT RECALL: AN INVESTIGATION OF TWO CONFLICTING HYPOTHESES

Maureen Machiels-Bongaerts, Henk G. Schmidt & Henny P.A. Boshuizen
University of Limburg, Maastricht, The Netherlands

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Maureen Machiels-Bongaerts, Henk G. Schmidt and Henny P.A. Boshuizen
University of Limburg, Maastricht, The Netherlands

SUMMARY

Two hypotheses, the cognitive capacity hypothesis and the selective attention hypothesis, try to account for the facilitation effects of prior knowledge activation. They appear to be mutually exclusive since they predict different recall patterns as a result of prior knowledge activation. However, in experiments, supporting these hypotheses, different activation strategies were applied, resulting in different ways of text processing. This assumption was tested by providing two groups of subjects different activation techniques, resulting in dissimilar ways of processing the same text. These strategies led to different recall patterns, predicted by the two forementioned hypotheses.

INTRODUCTION

Prior knowledge activation facilitates subsequent processing of information relevant to this knowledge. What a student already knows determines the way in which new information is encoded and retrieved from memory (Anderson, 1977).

Various hypotheses try to account for this phenomenon, including the selective attention hypothesis and the cognitive capacity hypothesis. These theories seem to be mutually exclusive since they lead to different predictions about what will be remembered of a text. However, a direct comparison of the hypotheses is quite impossible, for the experiments providing evidence for these hypotheses vary in ways of operationalization and variables. These operationalization differences of prior knowledge activation led to different approaches in text processing, resulting in dissimilar recall patterns, predicted by the two hypotheses.

The cognitive capacity hypothesis predicts that recall would be better for the text as a whole. According to this hypothesis, prior knowledge activation increases the accessibility of relevant information, and on being encountering during subsequent text processing, such information requires relatively little cognitive capacity. The remaining capacity can therefore be spent on processing information for which no activation took place. Due to prior knowledge activation, the attention shifts from activated information, which requires little processing capacity, to new, important information. Thus, it has been shown that an experimental group having activated prior knowledge can process more information than a control group in the same amount of time (Schmidt, 1982). Prior knowledge activation improves recall performance of the text as a whole. Peeck, Van den Bosch and Kreupeling (1982), for instance, activated students' prior knowledge about the appearance and habits of a fox by encouraging them to bring to mind ("mobilize") relevant prior knowledge about this subject. The text, describing a fictional animal (American heath fox), provided statements that were either in agreement with the activated knowledge ("congruous information") or contradictory to the activated prior knowledge on fox-like animals ("incongruous information"). The mobilization group recalled more incongruous information, compared to a control group, while the groups did not differ in recall of congruous information. Thus, the mobilization group excelled in recall of the text as a whole, due to the better recall performances for new information for which no activation took place.

The second explanation for the facilitation effects of prior knowledge activation on information processing, the selective attention hypothesis, predicts that prior knowledge activation only results in a better recall of activated information (Reynolds, Standiford & Anderson,

1979; Reynolds & Anderson, 1982). According to this hypothesis, the reader selectively pays attention to text relevant to the prior knowledge activated, which is therefore better remembered. Pichert and Anderson (1977), for instance, presented subjects with a text, describing the adventures of two boys, playing hooky from school, in the house of one of them. Prior knowledge was activated by asking one group of subjects to imagine they were a burglar and another group to pretend they were a potential homebuyer. By providing subjects such a perspective from which the text should be read, a burglar or homebuyer schema was activated. The essential elements of these schemata ('slots') could be filled with text elements during reading. Text elements like 'coin collection' and '10-speed bikes', demonstrating the wealth of the owners, would fill slots of the burglar schema, whereas text elements like 'old rotted roof' and 'damp basement', illustrating the house's condition, would correspond with the slots of the homebuyer schema. Information relevant to the assigned perspective from which the text was read, was recalled better than information that was irrelevant to this perspective. In other words, activated (perspective) information was recalled better than information for which no activation took place. Goetz, Schallert, Reynolds and Radin (1983) also demonstrated that subjects gave a higher rating to information relevant to the perspective from which the text was read than to information irrelevant to this perspective. Reading times showed the same pattern. More time was spent on sentences containing information that was relevant to the assigned perspective, which resulted in better recall for this information.

A closer scrutiny of the operationalization of prior knowledge activation, used in studies supporting the two hypotheses, suggests that the applied activation strategies (i.e. mobilizing prior knowledge versus assigning a reading perspective) resulted in different ways of text processing.

The activation procedures, employed by Peeck, Van den Bosch and Kreupeling (1982), Peeck (1982) and Schmidt (1982), led students to elaborate on the activated knowledge. Since relatively little cognitive capacity was required to process activated information due to the prior knowledge activation, subjects could focus on new, important text information. By integrating this new information, for which no activation took place, the existing (activated) knowledge could be extended, which is a goal of education. Thus, in these experiments the text in its original form, of which a part corresponded with the activated knowledge, was the central issue during text processing.

By contrast, the activation task, applied in experiments that support the selective attention hypothesis, forced subjects to pick up fairly isolated information from text. Providing subjects with a specific reading perspective enabled text elements without any special meaning in the text itself to become relevant for they filled the slots of the activated schema. In other words, in these studies the original text (for instance, Pichert & Anderson's story about two boys skipping school) is largely ignored. During reading, the subjects are constantly selecting information, corresponding with the slots of the activated schema. Every text element, irrespective of its importance in the text itself, would be ignored and therefore forgotten if it did not appear to be a piece fitting in the puzzle.

The aim of the present study was to investigate whether the assumption is correct that the two hypotheses, explaining the facilitation effect of prior knowledge activation, only appear to be diametrically opposed. In the experiments providing support for the two hypotheses, different activation techniques were applied. This could lead to dissimilar reading tasks, resulting in different recall patterns. To examine this assumption, two groups of subjects read the same text, describing the consequences of the E.E.C. fishery policies for a small (non-existent) village in Portugal. Activation for both groups took place by means of one technique, mobilization. In other words, subjects were explicitly asked to generate all their knowledge in a particular domain.

One group of subjects was requested to generate all their knowledge about the E.E.C. fishery policies, very much 'in the news' at the time of testing. The activated knowledge ('protection of the fish stock', 'fishery quota', 'penalties', 'bankruptcy') corresponded with the core of the text itself, namely the part in which the problem of the text (i.e. the consequences of

the E.E.C. fishery policies) was described. As a result of the activation, this group of subjects, hereafter called the 'problem group' since they activated knowledge that corresponded with the 'problem information' of the text, was expected to be anticipating a possible solution. In other words, this group would profit from the facilitation effect of prior knowledge activation and would therefore spend little capacity on processing 'problem information', for this information was already highly accessible. To extend their knowledge of the problem, they would use the remaining capacity largely to study text information, in which a solution for this problem was provided ('solution information'). This new, important information would therefore be recalled well, without impairment of the recall of the activated ('problem') information. Thus, the recall pattern of the problem group would reflect the predictions of the cognitive capacity hypothesis.

The second group of subjects was expected to show the recall pattern predicted by the selective attention hypothesis. This group was asked to mobilize information that could be important for a tour operator, who had to select new holiday locations. The slots of this schema could be filled with text elements, providing specific information ("couleur locale") about the village (hereafter called 'tourism information'). These fairly isolated text elements, rather redundant in the text itself, would get a special meaning due to the activation task. Therefore, this group of subjects (hereafter called the 'tourism group') would try to fill the slots of the activated schema by constantly selecting matching information. Text elements, irrespective of their importance in the text itself, would be ignored and therefore forgotten if they did not fit into one of these slots. Therefore, as predicted by the selective attention hypothesis, activated information would be recalled better than information irrelevant to the activated schema.

METHOD

Subjects

In this study two groups of ten subjects participated: the 'problem group' mobilized knowledge corresponding to the core of the text in which the consequences of the E.E.C. fishery policies were described ('problem information'), and the 'tourism group' mobilized knowledge, that could be important for a tour operator who had to select new holiday locations.

Material

The text contained three different information types, each consisting of ten sentences: 'problem information', in which the consequences of the E.E.C. fishery policies were described; 'solution information', in which a solution for the problem was provided; 'tourism information', which provided specific information about the village ("couleur locale"). To build a coherent text, 27 filler sentences were added ('residual information'). Both the problem information and the solution information were important parts in the text, whereas the tourism information reflected text details.

Procedure

During the mobilization phase, the problem group was explicitly asked to generate all their knowledge of the consequences of the E.E.C. fishery policies. Knowledge about the advantages and disadvantages was generated (for instance, 'control of fish stock', 'loss of competition', 'illegal fishery', 'bankruptcy'). The tourism group was asked to generate everything that would be of importance for a tour operator who had to select new holiday locations (for instance, 'climate', 'environment', 'sightseeing', 'infrastructure').

After the mobilization phase, the two groups read the text once. While reading, they had to mark all text elements that were important with respect to their instruction. The problem information was assumed to be relevant for the problem group and the tourism information for the tourism group. Thus, the task was designed to test whether mobilization was an effective strategy to activate prior knowledge.

Subsequently, to divert the subjects from the literal wording of the text, subjects had to answer in writing a number of (medical) questions during 20 minutes (Keenan & Kintsch, 1974).

Finally, subjects were asked to recall orally everything they could remember of the text. The subjects' free recall was recorded on tape.

Analysis

The reading text was divided into propositions, resulting in a text base. For every subject, the number of marked propositions was calculated for each type of information. The recall protocols were transcribed. For each subject, the number of propositions correctly recalled was established. In order to estimate the reliability of this procedure, six of the twenty recall protocols were selected at random. Two independent raters scored the number of correspondences (literal or paraphrase) between the text base and these six protocols. The interrater agreement was 88%.

RESULTS AND CONCLUSIONS

This experiment tested the assumption whether the cognitive capacity hypothesis and the selective attention hypothesis only seem to be diametrically opposed. Two groups of subjects read the same text once. Prior to the study phase two activation techniques were applied, resulting in different reading tasks. The results of the problem group, mobilizing knowledge corresponding to an important text part ('problem information'), would reflect the predictions of the cognitive capacity hypothesis. The reading goal of this group was learning; in other words, extending the activated knowledge network. Therefore, the group would focus on processing new and important information ('solution information'), resulting in better recall of the text as a whole. On the other hand, the results of the tourism group was expected to correspond with the predictions of the selective attention hypothesis. Prior to the study phase, the latter group mobilized a schema, the slots of which could be filled in with text elements during text processing. Therefore, this group's attention would be drawn to information that corresponded to the activated knowledge. Information that did not match the activated schema would be largely ignored, irrespective of the importance of this information in the text.

To investigate whether the two activation strategies were effective, the subjects of the two groups had to mark during the study phase every text element that was relevant according the instruction.

Table 1 shows the mean number of propositions, marked during reading, for the two groups.

Table 1

Mean number of propositions, marked by the problem group and the tourism group (maximum = 45)

	Problem info	Solution info	Tourism info	Residual info[1]	Total
Problem group	25.0	8.5	4.7	14.3	52.5
Tourism group	0.6	1.3	28.4	6.5	36.8

[1] The fourth category, the residual information consisted of 122 propositions. The problem group marked 38.7 propositions; the tourism group underlined 17.5 propositions. To permit comparisons between the four categories, these results were transformed to a scale with a minimum of 0 and a maximum of 45.

The problem group principally marked more text elements concerning the problem information[1]; for the tourism group the tourism information was most relevant[2]. These data show that the activation strategy was effective.

Table 2 contains the mean number of propositions correctly recalled by the two groups.

Overall the problem group recalled more propositions than the tourism group ($F(1,18 = 20.082, p < .0001$).

The recall protocols of the problem group showed that the new, important information ('solution information') had become relevant, although during reading, mainly problem information was marked as relevant. The mean number of propositions of the solution information marked during reading was only 8.5; for recall, this number quadrupled (34.3). Despite the significant increase in recall of solution information ($t(9) = 7.918, p < .0001$), recall of problem information was not impaired as the mean number of propositions recalled was almost equal to the number of propositions marked during reading ($t(9) < 1$). The problem group also showed an increase in recall of tourism information ($t(9) = 7.425, p < .01$) and residual information ($t(9) = 8.043, p < .01$).

Table 2

Mean number of propositions, correctly recalled by the problem group and the tourism group (maximum = 45)

	Problem info	Solution info	Tourism info	Residual info[2]	Total
Problem group	24.5	34.3	11.6	21.3	91.7
Tourism group	4.3	8.0	23.5	6.5	45.8

[2] As the residual information consisted of 122 propositions, these data were transformed. On a untransformed basis, the problem group recalled 57.5 propositions and the tourism group 29.6 propositions in this category correctly.

The tourism group did not show such a large rise in recall, compared to the number of propositions marked during reading[3]. This group retained to the text elements that filled the slots of the activated schema. The number of propositions of the tourism information marked during reading did not differ from the mean number of propositions correctly recalled ($t(9) = 1.236, p = .25$).

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[1] The problem group marked significantly more problem information than solution information ($t(9) = 7.942, p < .0001$); these subjects also marked more problem information than tourism information ($t(9) = 15.514, p < .0001$) or residual information ($t(9) = 9.061, p < .0001$).

[2] The tourism group marked more tourism information than problem information ($t(9) = 18.304, p < .0001$); this group also marked significantly more tourism information than solution information ($t(9) = 19.33, p < .0001$) or residual information ($t(9) = 12.123, p < .0001$).

[3] This group did not show an increase in recall of problem information, compared to the mean number of propositions of this information type marked during reading ($t(9) = 1.986, p = .08$), nor a rise in recall of residual information ($t(9) = 2.144, p = .06$). This group, however, recalled more solution information compared to the mean number of propositions marked during reading ($t(9) = 4.265, p < .01$).

DISCUSSION

These results indicate that both the selective attention hypothesis and the cognitive capacity hypothesis could be valid. The nature of the reading tasks as a result of the activation techniques applied, could have caused the differences in recall patterns, predicted by the two hypotheses.

The results of the tourism group reflected the predictions of the selective attention hypothesis. During the mobilization phase, the tourism group activated a schema that was filled in with text elements during reading. This group mainly recalled tourism information, for this information category corresponded to the slots of the activated schema; the remaining information, although very important in the text itself, was largely ignored.

Compared to the number of marked propositions, the problem group showed an increase in recall of new, important information, while recall of activated information was not impaired. This pattern was predicted by the cognitive capacity hypothesis. During the mobilization phase, the accessibility level of the problem information was raised; therefore, relatively little capacity was required to process this information. The remaining capacity could be spent on processing important information, for which no activation took place. Due to the mobilization, this group was eager to study a possible solution for the activated problem. By integrating this new information into the activated information, this group could elaborate their knowledge in this domain.

Overall the problem group recalled more information than the tourism group since the reading goal of this group was to extend the existing knowledge network. The problem group's representation of the original text was also more coherent. This was shown by a larger number of relations linking the concepts of the text. The recall protocols of the problem group showed more relations linking the concepts of the text than the protocols of the tourism group. The adjusted mean number of relations between concepts, correctly recalled, was 40.4 for the problem group, whereas the score of the tourism group was only 16.5.

The results of this study show that the selective attention hypothesis and the cognitive capacity hypothesis, both explaining the facilitation effect of prior knowledge activation, only appear to be mutually exclusive. Further research, in which the reading time for each type of information is recorded, is of great importance to explore the predictions of the cognitive capacity hypothesis. By manipulating available reading time, the effect of prior knowledge activation on text processing could be investigated more closely.

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